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**FLEXIBLE BAR-TYPE BACK PIVOT MOUNTING  
ARRANGEMENT FOR A CHAIR**

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CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Serial  
5 No. 60/270,851, filed February 23, 2001.

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to seating furniture, and more particularly to an  
arrangement for pivotably mounting a back to a seat in a chair or other seating furniture  
arrangement.

10 Various arrangements are known for providing pivoting movement of a  
chair back relative to a seat. One example is illustrated in Ambasz U.S. Patent  
4,084,850, which discloses a sleeve mounted to each side of a chair back and the upper  
end of a rod pivotably engaged with the lower end of the sleeve. The rod extends  
15 through a passage defined by a cylindrical retainer engaged with the seat, or with an  
upright extending upwardly from the seat. The rod defines an enlarged lower end, and a  
spring bears between the lower end of the rod and the lower end of the cylindrical  
retainer. Pivoting movement of the back causes the rod to move upwardly relative to the  
cylindrical retainer and functions to compress the spring, such that the spring resists  
20 rearward movement of the chair back and provides forward pressure on the user's back.  
While this type of arrangement has been found to operate satisfactorily, it involves a  
number of components which must be assembled together in order to effectuate  
pivotable mounting of the back to the seat.

The '850 patent illustrates other alternative arrangements, including a lever  
arm extending downwardly from the seat into a passage defined by an upright seat  
25 mounting section, with a resilient compressible member being engageable with the lever  
arm. This arrangement provides compression of the resilient member as the seat is  
pivoted rearwardly, which resists such rearward movement and provides a forward bias  
to the back.

It is an object of the present invention to provide a simplified back pivot  
30 arrangement for a chair, which reduces the number of parts and assembly steps required  
to mount the back to the chair, and which provides satisfactory pivoting movement of

the back relative to the seat. It is another object of the invention to provide such a back pivot arrangement which is capable of providing progressively increasing resistance during rearward pivoting movement of the back relative to the seat. It is a further object of the invention to provide such a back mounting arrangement which limits pivoting movement of the back relative to the seat without contact between the back and the seat. A still further object of the invention is to provide such a back mounting arrangement which is extremely simple in its components and their construction and assembly, yet which provides highly satisfactory pivoting movement and resistance of the back relative to the seat.

In accordance with the invention, seating furniture such as a chair includes a seat member and a back member, which are formed with facing open pockets or passages. A flexible bar-type pivot member includes a lower section adapted to be received within the seat member passage and an upper section adapted to be received within the back member passage. The seat member and the back member define facing surfaces which are spaced apart from each other, and an intermediate portion of the pivot member is located within the space and between the upper and lower sections of the pivot member. A limit member, which may be in the form of a limit strap, is engaged with the pivot member for limiting rearward movement of the back member relative to the seat member.

The upper and lower ends of the pivot member are fixed relative to the back member and the seat member, respectively. When the back member is in its at-rest position, a gap is defined between the upper section of the pivot member and the rear surface of the back member passage, and a gap is also defined between the lower section of the pivot member and the rear surface of the seat member passage. With this arrangement, the pivot member initially flexes rearwardly to engage the pivot member with the upper end of the seat member passage when initial rearward pressure is applied to the back member. Additional rearward pressure causes engagement of the pivot member with the lower end of the back member passage. Thereafter, resistance to rearward pivoting movement is provided by the intermediate section of the pivot member, which is configured and has a thickness which provides a relatively high degree of resistance.

The limit member overlies the pivot member, and is operable to control the range of movement of the back member relative to the seat member. The limit member and the pivot member define cooperating engagement structure, which is operable to prevent additional bending of the pivot member when the back member has attained a predetermined angular position relative to the seat member. Representatively, the pivot member is provided with upper and lower protrusions which extend from a front surface of the pivot member. The limit member has spaced apart openings which receive the pivot member protrusions, and one or both of the limit strap openings are slightly larger than the pivot member protrusions. During pivoting movement of the back member, the front of the pivot member becomes slightly elongated and the back of the pivot member becomes slightly compressed. In this manner, the limit member opening engages the pivot member protrusion when the back member is pivoted to a predetermined angle relative to the seat member, to prevent further bending of the pivot member and thereby to limit movement of the back member relative to the seat member. When rearward pressure on the back member is relieved, the resiliency of the pivot member and the limit member function to return the back member to its original position.

Various other features, objects and advantages will be made apparent from the following detailed description taken together with the drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

Fig. 1 is an isometric view of a chair incorporating the back mounting arrangement of the present invention;

Fig. 2 is an isometric view of a chair shell incorporated into the chair of Fig. 1;

Fig. 3 is a section view taken along line 3-3 of Fig. 2, showing the back member of the chair in its upright position;

Fig. 4 is an enlarged partial section view showing the components of the back mounting arrangement of Fig. 3, again showing the back member in its upright position;

Fig. 5 is a view similar to Fig. 4, showing the back member in its full rearwardmost position;

Fig. 6 is an exploded elevation view illustrating the pivot member and the limit strap of the back mounting arrangement incorporated into the chair of Fig. 1;

Fig. 7 is a partial elevation view with reference to line 7-7 of Fig. 6;

Fig. 8 is an elevation view illustrating the limit strap shown in Fig. 6;

Fig. 9 is a section view taken along line 9-9- of Fig. 4; and

Fig. 10 is a section view taken along line 10-10 of Fig. 5.

#### DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1 and 2, a chair 18 includes a shell assembly 20 having a seat section or member 22 and a back section or member 24. Seat member 22 includes a seat pan 26 which is curved upwardly at its rear end and merges with a lower back area 28. A pair of upwardly facing lower receiver sections 30 are located one on either side of lower back area 28. Each lower receiver section 30 defines an upwardly open pocket or passage 32.

Back member 24 defines an upper back area 34 and a pair of upper receiver sections 36 located one on either side of upper back area 34. Each upper receiver section 36 defines a downwardly open pocket or passage 38. Lower and upper receiver sections 30, 36, respectively, define facing upper and lower edges 40, 42, respectively, which are spaced apart from each other. A bellows member 43 is engageable with the upper end of each lower receiver section 30 and the lower end of each upper receiver section 36, for concealing the space between lower and upper edges 40, 42, respectively, and for accommodating pivoting movement of back member 24 relative to seat member 22.

Lower back area 28 terminates in a downwardly recessed transverse upper edge 44, and upper back area 34 terminates in an upwardly recessed transverse lower edge 46. Upper edge 44 and lower edge 46 cooperate to define an open area 48 located between lower back area 28 and upper back area 34.

A pair of bar-like resilient pivot members 50 are engaged with lower receiver sections 30 and upper receiver sections 36, for pivotably mounting back member 24 relative to seat member 22. Each pivot member 50 defines a lower portion received within passage 32 in lower receiver section 30, an upper portion received within passage 38 in upper receiver section 36, and an intermediate area 52 located between upper and lower edges 40, 42 of lower and upper receiver sections 30, 36, respectively, which is concealed by bellows member 43 mounted between upper and lower edges 40, 42, respectively.

Each resilient pivot member 50 is a composite member, including a flexible resilient pivot bar 54 and a limit strap 56.

Passage 32 in each lower receiver section 30 is in the form of an upwardly facing passage or pocket having rear ribs 33a and front ribs 33b, within which the lower portions of pivot bar 54 and limit strap 56 are received. Similarly, passage 38 in upper receiver section 36 is in the form of a downwardly facing passage or pocket having front ribs 39a and rear ribs 39b, within which the upper portions of pivot bar 54 and limit strap 56 are received. Fig. 3 illustrates one of resilient pivot members 50 positioned between seat member 22 and back member 24.

Referring to Figs. 4-6, resilient pivot bar 54 includes a lower section 58 and an upper section 60, between which intermediate area 52 is located. Lower section 58 and upper section 60 are angularly offset from each other. Representatively, lower section 58 and upper section 60 are formed so as to define an angle of 159° therebetween, although it is understood that any other satisfactory angle could be utilized. Lower section 58 and upper section 60 define areas of increased thickness 62, 63, respectively. Lower and upper forwardly facing rectangular protrusions 64, 66, respectively, extend outwardly from the forward surface of pivot bar 54. Lower protrusion 64 includes a forward extension 65, and upper protrusion 66 includes a forward extension 67. A pair of apertures 68, 70 extend inwardly from the rear surface of pivot bar 54 at the locations of protrusions 64, 66, respectively. In addition, a lower transverse boss 71 and an upper transverse boss 73 extend rearwardly from the rear surface of pivot bar 54. Pivot bar 54 is formed of any satisfactory resilient material, and

representatively may be formed of a nylon 6/6 material, although it is understood that other satisfactory materials may be employed.

Lower protrusion 64 and upper protrusion 66 may be formed to have an identical transverse dimension. The longitudinal dimension of lower protrusion 64 equals the transverse dimension, such that lower protrusion 64 is generally square with slightly rounded corners. The longitudinal dimension of upper protrusion 66 is slightly less than the transverse dimension, such that upper protrusion 66 is generally rectangular, defining a height less than its width. Representatively, lower protrusion 64 has a height and width of 0.480 inches, and upper protrusion 66 has a width of 0.480 inches and height of 0.420 inches.

Referring to Figs. 6-8, limit strap 56 is in the form of an elongated rectangular member having a length slightly less than that of pivot bar 54. Lower and upper rectangular openings 72, 74, respectively, are formed adjacent the ends of limit strap 56. Openings 72, 74 have a shape which generally corresponds to that of lower and upper protrusions 64, 66, respectively, in pivot bar 54. Openings 72, 74 each define an area slightly greater than that of lower protrusion 64, and are generally square in shape with rounded corners. Representatively, each side of each opening 72, 74 has a dimension of 0.500 inches. When pivot bar 54 and limit strap 56 are positioned together such that limit strap 56 lies against the front surface of pivot bar 54, lower protrusion 64 is received within lower opening 72, and the close tolerances between the edges of lower protrusion 64 and lower opening 72 substantially fix the lower end of limit strap 56 in position relative to pivot bar 54. Upper protrusion 66 is received within upper opening 74, and the differential in height between upper protrusion 66 and upper opening 74 provides a gap which is located between the upper edge of upper protrusion 66 and the upper edge of upper opening 74, as shown in Fig. 9.

Each resilient pivot member 50, which includes a pivot bar 54 and a limit strap 56, is engaged within the ribbed pocket in one of lower receiver sections 30 defined by passage 32, by fitting limit strap 56 and pivot bar 54 together such that lower protrusion 64 is received within lower opening 72 and the assembled pivot bar 54 and limit strap 56 are inserted into passage 32 so that the lower end of pivot bar 54 bottoms out against the end of passage 32. Forward extension 65 of protrusion 64 fits between a

pair of the forward ribs 33b of passage 32, and engages the front wall of passage 32.

The lower rear area of pivot bar 54 engages the rear ribs 33a associated with passage 32.

A fastener, such as a threaded screw 75, is then driven in a rearward-to-forward

direction through the rear wall of lower receiver section 30 and into aperture 68 in pivot

5 bar lower section 58, to retain pivot bar 54 and limit strap 56 in position relative to seat member 22. Passage 32 and its associated ribs 33a, 33b are configured to provide a secure mount for the bottom of lower section 58 against rearward and forward

movement. A space 80 is defined between the rear surface of pivot bar 54 and the

forwardly facing edges of the rear ribs 33a of passage 32, at the upper end of pivot bar

10 lower section 58. When engaged with receiver sections 30 in this manner, lower section 58 of pivot member 50 extends upwardly at an angle of approximately 2° forwardly relative to vertical, to provide a slight forward bias for back member 24.

In a similar manner, upper section 60 of pivot member 50 is received

within passage 38 formed in upper receiver section 36. The upper end of pivot bar 54

15 bottoms out against the upper end defined at the merger of ribs 39a, 39b associated with passage 38, which are configured to maintain the majority of the length of pivot member upper section 60 in a position engaging ribs 39b associated with the forward wall of passage 38. Upper transverse boss 73 engages the front edges of ribs 39a, to space the upper end of pivot bar 54 forwardly of ribs 39a. Forward extension 67 of upper

20 protrusion 66 fits between a pair of forward ribs 39b of passage 38, and engages the forward wall of passage 38 between the pair of forward ribs 39b. Limit strap 56 is captured between the forward surface of pivot bar 54 and the forward ribs 39b of

passage 38. A threaded fastener, such as a screw 75, is inserted in a rearward-to-

forward direction utilizing an indentation 76 formed in the rear wall of back member 24,

25 and extends into engagement with pivot bar upper section 60 at aperture 70. A space 82 is defined between the rear surface of pivot bar 54 and the forwardly facing edges of the rear ribs 39a of passage 38, at the lower end of pivot bar upper section 60.

When pivot members 50 are secured to and between seat member 22 and back member 24 as shown and described, upper section 60 of each resilient pivot

30 member 50 is oriented at approximately a 19° rearward angle relative to vertical. Back member 24 is constructed such that upper back area 34 provides a shape corresponding

to the typical configuration of a user's back, in cooperation with lower back area 28 of seat member 22. The orientation of lower section 58 provides a lumbar support feature.

In operation, pivot members 50 function as follows to enable back member 24 to move relative to seat member 22.

5 When the user leans back against back member 24 to apply rearward pressure on upper back area 34, pivot members 50 flex so as to allow back member 24 to move rearwardly relative to seat member 22. When the rearward pressure on upper back area 34 is relieved, the resiliency of pivot bar 54 returns back member 24 to its normal, at-rest position. During such rearward flexing of pivot bar 54, the front face of  
10 pivot bar 54 becomes slightly elongated and the rear face of pivot bar 54 becomes slightly compressed, to enable rearward movement of back member 24 and to provide the forward bias tending to return back member 24 toward its upright, at-rest position. The presence of the gap between the upper edge of upper protrusion 66 and the upper edge of upper opening 74 in limit strap 56 accommodates the slight elongation of the  
15 forward surface of pivot bar 54 during normal movement of back member 24.

The configuration and materials of pivot bars 54 are selected so as to provide an increasing resistance feature, i.e. pivot members 50 provide greater resistance as the pivot angle of back member 24 increases. This is in contrast to prior art pivot arrangements, which provide a relatively high initial resistance but which provide low  
20 resistance to subsequent movement as the back angle increases. During pivoting movement of back member 24, the upper end of lower section 58 of pivot member 50 first flexes rearwardly to move lower transverse boss 71 into engagement with the front edges of rear ribs 33a, to close space 80. Pivot bar 54 then engages the upper areas of the rear ribs 33a of lower passage 32, to prevent further flexing of lower section 58.  
25 This functions to sequentially shorten the lever arm of pivot member 50, and subsequent bending of pivot bar 54 occurs at the lower end of upper section 60. The lower end of upper section 60 then flexes rearwardly and closes space 82, to engage the lower areas of the rear ribs 39a of upper passage 38, to provide resistance to further rearward pivoting movement. Thereafter, intermediate area 52 of pivot bar 54 flexes to provide  
30 resistance to movement of back member 24. This construction of the lower receiver section 30, upper receiver section 36 and pivot bar 54, including increased thickness

areas 62, 63, is operable to provide a progressive resistance feature which increases bending resistance as back member 24 is increasingly pivoted rearwardly.

When the user exerts a significant rearward force on upper back area 34 to move back member 24 rearwardly, and continues application of such a force, pivot members 50 will flex so as to accommodate such movement until a sufficient angle is attained so as to cause the upper edge of upper protrusion 66 to engage the upper edge of upper opening 74 in limit strap 56, as shown in Fig. 10. When this occurs, further rearward pivoting movement of back member 24 is prevented, such that limit strap 56 is operable to limit rearward movement of back member 24 relative to seat member 22.

Again, when the rearward pressure on upper back area 34 is relieved, the resilience of pivot bar 54 functions to return back member 24 to its upright position.

Limit strap 56 is formed of a generally rigid, resilient material such as spring steel 1095, which enables limit strap 56 to be repeatedly flexed and returned to its original condition without fatigue.

Representatively, limit strap 56 and pivot bar 54 are formed so as to provide a pivot stop at a flex angle of approximately 25° back, which has been found to provide sufficient back flex for the majority of users.

The ribs 33a, 33b and 39a, 39b defined in lower and upper passages 32, 34, respectively, function to provide a necessary draft for molding of seat and back members 22, 24, respectively, and also function to dissipate forces experienced by pivot bar 54 when pivot bar 54 engages the walls of passages 32, 38, to prevent local failure of pivot bar 54.

While the invention has been shown and described with respect to a particular embodiment, it is understood that alternatives and variations are possible and are contemplated as being within the scope of the present invention. For example, and without limitation, while the limit feature is shown as being associated with the upper pivot bar protrusion and strap opening, it is also possible to provide the limit feature in association with the bottom protrusion and strap opening, or with both the upper and lower protrusions and openings. While the invention has been shown and described in connection with protrusions on the pivot bar and openings in the limit strap, it is also

provided on the limit strap and the openings or recesses associated with the pivot bar.

The limit member has been illustrated as being in the form of a flexible strap-like member, but it is also understood that the limit member may have any other satisfactory configuration. While the limit member has been shown and described as limiting

5 pivoting movement of the back by interacting with the tensioned and elongated front of the pivot strap, it is also understood that a similar type of limiting interaction may be provided in connection with engagement structure associated with the limit member and the compressed rear surface of the limit strap. In addition, while a ribbed pocket configuration is illustrated for receiving the upper and lower ends of the pivot members, 10 it is also contemplated that any other type of receiver structure may be employed for receiving the upper and lower ends of the pivot members. Further, the illustrated back angles are representative only, and it is understood that other back angles may be provided as desired. While the specification and drawings illustrate a pair of pivot members mounted at opposite sides of a chair, it is understood that a similar 15 configuration could be employed in connection with one or several pivot members which operate similarly to that as shown and described.

Further, while limit strap 56 has been shown and described as limiting the extent of rearward movement of back section 24 relative to seat section 22, it is also understood that limit strap 56 may be eliminated and a stop arrangement interposed 20 between the lower end of back section 24 and the upper end of seat section 22, for limiting the extent of rearward pivoting movement of back section 24 relative to seat section 22.

Various alternatives and embodiments are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the 25 subject matter regarded as the invention.